(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 June 2001 (28.06.2001)

PCT

(10) International Publication Number
WO 01/46900 A1

(51) International Patent Classification[7]: G06K 11/08

(21) International Application Number: PCT/US00/35018

(22) International Filing Date: 21 December 2000 (21.12.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/469,634 22 December 1999 (22.12.1999) US

(71) Applicant (*for all designated States except US*): AGION TECHNOLOGIES, LLC [US/US]; Welch, Ed, 60 Audubon Road, Wakefield, MA 01880 (US).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): TROGOLO, Jeffrey [US/US]; 228 Commonwealth Avenue, Boston, MA 02116 (US). FRIEDMAN, Roger [US/US]; One Governors Row, West Hartford, CT 06116 (US). BARRY, John [US/US]; 18 Drake Lane, Derry, NH 03038 (US).

(74) Agent: HULTQUIST, Steven, J.; Intellectual Property/Technology Law, 6320 Quadrangle Drive, Suite 110, Chapel Hill, NC 27514 (US).

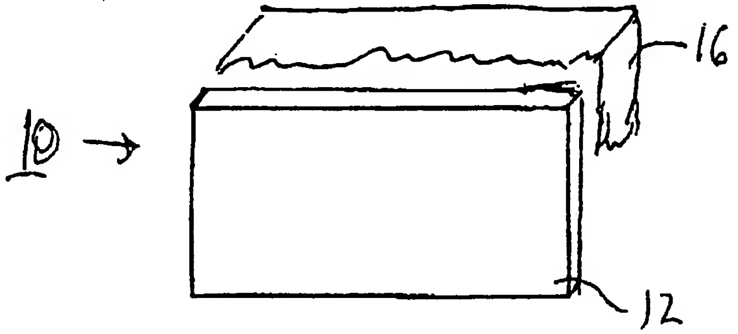
(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*
— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: TOUCH SCREEN WITH ANTIMICROBIAL PROPERTIES



(57) Abstract: A touch screen for computer input having an outer surface that is to be touched by a user containing an inorganic antimicrobial agent. The agent, which can be a zeolite, is present at the surface in an effective amount to kill or retard growth of bacteria. The agent can be incorporated in a plastic resin forming the layer of the touch screen that includes the outer surface, contained in a coating applied to the outer layer of the touch screen, or contained in a laminate that is applied to the touch screen outer layer.

WO 01/46900 A1

TOUCH SCREEN WITH ANTIMICROBIAL PROPERTIES

Field of the Invention

The present invention relates to touch-type screens used with computers having antimicrobial properties.

Background of the Invention

Touch-type screens or touch screens are used in computer applications for input of data, such as in automatic teller machines, cash registers, inventory control devices, kiosks to provide information, restaurants for food order entry, gaming systems, industrial control applications, telephone number entry, and for general purpose computer data input. Such screens for inputting data are available in add-on form to be associated with an exiting video display device or are integrated as part of a display device. The screens are associated with a display of data to be entered into computers. The data can appear on the display device with which the touch screen is associated or as a printed graphic display that is part of the touch screen.

The touch screens, whether of the add-on or integrated type, utilize a variety of technologies. They all include an outer layer whose outer surface is to be touched at a location to input the desired data and various other components, such as additional underlying layers and electronic components. In resistive touch screens, finger pressure on specific areas of a deformable outer transparent screen layer completes a circuit to send a message to the computer for processing. Another type of screen uses strain gauges that react to pressure on a relatively rigid screen outer layer to measure the point at which pressure is applied to the outer layer. In a micro-wire type touch screen, each area on the screen is micro-wired as a grid with unique circuit characteristics whereby the particular point of the screen outer layer that is touched is identifiable.

Other touch screens include those of the capacitive type in which a finger touches the desired area on a rigid outer layer of electrical insulating material, such as glass or a plastic resin, for data input. The capacitive properties of the finger draws current to the point touched, which is then registered by the system.

In another type of touch screen, surface acoustic wave sensors (SAWs) transmit waves across a rigid screen, such as a screen having a glass outer layer. When the outer layer is touched, a disturbance is created in the wave pattern which allows the system to determine the area being touched.

IR (infra red) touch screens operate with beams of IR energy in a grid form projected across a screen outer layer. The beams are broken by the finger placement to determine a signal position.

Piezoelectric and optical type touch screens also are used.

In common to all of the above types of touch screens, and other types, is the fact that the exposed surface of the screen outer layer is touched by the fingers of a human. Since a number of people can touch any given screen, a problem exists of possible transfer of bacteria. That is, one person having unsanitary hands can touch a screen and leave a residue of bacteria. The next person touching the same part of the screen can pick up the bacteria and transfer it to his own body parts or transfer bacteria to others during normal body contact.

If the bacteria left on the screen is of a strain that can produce a harmful medical condition, the next and subsequent persons touching the screen possibly could be adversely affected by contact with the bacteria. Therefore, it would be desirable to maintain the screen in a sanitary condition, as free

of bacteria as possible, at all times. While the screen can be wiped with a liquid antiseptic solution to kill bacteria, this can only be done periodically. Also, a liquid antiseptic is not a long-lasting solution to the problem since the liquid will evaporate. Therefore, a need exits for a touch screen whose outer layer that is to be touched is provided with antimicrobial action that is continuous and long lasting.

Brief Description of the Invention

The present invention is directed to a touch screen associated with a computer, as an add on to a display device or which is an integral part of the device, wherein the screen has antimicrobial properties. In accordance with the invention, the touch screen which is to be touched by the user's finger comprises an inorganic antimicrobial agent in sufficient amount to impart a significant antimicrobial effect to the outer surface of the touch screen. The agent is present in an amount that is effective to kill, or reduce the growth of, bacteria while still leaving the screen transparent and operative for use by touch. In a preferred embodiment, the inorganic antimicrobial agent is ceramic particles comprising antimicrobial metal ions (e.g., zeolites), preferably of ceramic particles in an amount and of a type that does not adversely affect the screen transparency or electrical properties.

The agent can be incorporated in the resin forming the screen outer layer, or provided as a laminate or coating applied on the outermost screen layer. The agent is available over the entire surface area of the screen outer layer that is to be touched by the finger. The inorganic agent remains active over a long period of time.

Objects of the Invention

It is therefore an object of the invention to provide a touch screen that has antimicrobial properties for an input device associated with a computer.

A further object is to provide a touch type screen whose outer layer outer surface contains an inorganic antimicrobial agent.

Yet another object is to provide a touch screen in which the surface that is to be touched by a user's finger incorporates a zeolite to provide antimicrobial properties.

An additional object is to provide a touch screen in which an inorganic antimicrobial agent is incorporated in the material forming the screen outermost layer, is applied as a laminate to such outer layer or is coated onto the layer.

Brief Description of the Drawings

Other objects and advantages of the present invention will become more apparent upon reference to the following specification and annexed drawings in which:

Fig. 1 is a diagrammatic view of a type of touch screen having an outer layer that is rigid;

Fig. 2 is a diagrammatic cross-sectional view of a touch screen whose outer layer is of a deformable material;

Fig. 3 is a diagrammatic view of a touch screen in which a coating is applied to the outer layer; and

Fig. 4 is a diagrammatic cross-sectional view of a touch screen in which a laminate containing the antimicrobial agent is applied to the screen outer layer.

Detailed Description of the Invention

For all of the embodiments of the invention, a preferred antimicrobial agent is an agent comprising ceramic particles containing antimicrobial metal ions, such as a zeolite subject to ion exchange with antimicrobial metal ions, such as silver ions. Suitable zeolites are generally disclosed in U.S. Patents 4,938,955 and 4,906,464.

In the preferred embodiment of the invention, the inorganic antimicrobial agent is ceramic silver zeolite particles, such as AJ10D, made by Shinagawa Company of Osaka, Japan, and which are of a nominal 1.0 micron size.

The antimicrobial agent is present in an effective amount to impart antimicrobial properties to the screen surface to be touched by the user.

The amount of the antimicrobial agent will vary based on the specific inorganic agent used, its composition, the material with which it is mixed or added to, and upon known factors such as type and use of the product containing the agent. Environmental factors, such as the temperature of the environment where the touch screen is located and of any associated electronic components, also should be taken into consideration. It is within the ability of one skilled in the art to in view of this disclosure to relatively easily determine an effective amount of the antimicrobial agent to be used with each material.

Since the particle size of the agent is small, preferably 1.0 micron or less, incorporation into the screen outer layer material will not adversely affect the transparency needed for the touch screen if the amount of antimicrobial agent is not excessive.

Fig. 1 is a diagrammatic view showing the general principles of one type of touch screen 10. This is used for illustrative purposes. The invention is applicable to all of the foregoing types of touch screens discussed, and others. Here, the screen 10 has a rigid outer layer 12 of a plastic material, for example a polycarbonate such as sold under the name LEXAN. The touch screen outer layer 12 is of a desired thickness and is associated with a number of other components generally designated by reference numeral 16. For example, if the touch screen is of the IR type, there would be optoelectronic members, such as mounted in a bezel, around the perimeter of the outer layer 12, and various electronic components. The details of the other parts of the touch screen are conventional and are not critical to the subject invention. In the touch screen 10 of Fig. 1 the invention provides the antimicrobial agent on the entire outer surface of outer layer 12.

In Fig. 2, the touch screen 20 illustratively is of the pressure sensitive type. Here, the outer layer 22 is of a transparent elastomeric polymeric material having the agent available on the outer surface that is contacted and pressed by the user's finger. Fig. 2 is illustrative, for example, of a resistive, micro-grid or piezoelectric type of touch screen.

In Fig. 3, the outermost part of the touch screen 30 is a rigid plate 32 of transparent material such as a plastic resin or glass. Here, there is a transparent coating 34 as the outer layer that contains the inorganic antimicrobial agent. Fig. 3 is illustrative, for example, of a portion of a capacitive or strain gauge type of touch screen.

Fig. 4 shows a touch screen 40 whose outermost part also is a transparent plate 32 of glass or plastic resin. Here, a transparent laminate layer 44 containing the agent is bonded to the plate 32 as the outer layer containing the agent. Fig. 4 also is illustrative of a capacitive or strain gauge type of touch screen.

In accordance with the invention, the transparent outer layer of the touch screen of the types described above or of any other type that is to be touched by the user's finger is to be provided with antimicrobial properties. To accomplish this, the antimicrobial agent is to be present on the surface of the screen outer layer that is to be touched by the finger. Provision of the agent for the various screen configurations is described below.

Antimicrobial Agent is incorporated in a resin rigid outer layer. One type of outer layer of the touch screen, such as shown in Fig. 1, is made of a resin material, such as a polycarbonate. One such well-known type of this material is sold under the name LEXAN. For a touch screen whose outer layer is of a plastic resin material, the agent is preferably incorporated into the resin from which such layer is made.

The resins into which the zeolite is incorporated can be those such as polyurethane, polyethylene, polypropylene, polystyrene, polyvinyl chloride, polycarbonates and others as disclosed in said patents. Methods of zeolite incorporation are disclosed in the foregoing U.S. Patents 4,938,955 and 4,906,464.

The ceramic silver zeolite particles of the preferred embodiment can be incorporated, such as by kneading, into the resin for the screen layer and the layer formed in its normal manner, such as by molding, casting or extrusion.

The ceramic particles are mixed with the resin in the manner described in the aforesaid patents. The concentration of the particles of the agent is preferably in the range of from 0.1 to 20.0 wt%, more preferably from 0.1 to 10.0 wt%, and most preferably from 0.5 to 5.0 wt% of the total weight of the resin forming the screen outer layer.

The inorganic antimicrobial agent in the form of the zeolite particles is available throughout the entirety of the screen outer layer, including the entire outer surface that is to be touched by the user, to perform its antimicrobial action. The agent kills or reduces the growth of bacteria on such surface.

In general, the antibiotic particles are preferably present in an effective amount in a concentration by weight in the resin used to form the screen layer to impart antimicrobial properties to the screen layer. This means that there is a sufficient amount of the antimicrobial agent added to or combined with other materials, such as resin to form the layer, so as to be present on the exposed surface to prevent or inhibit the growth of bacterial and/or fungal organisms or to kill such organisms. This is within the skill of the art in light of the present specification.

It is preferred that the final amount of the zeolite particles be in the range of from about 0.5 to 2.0% of the total weight of the resin for the screen layer so that it will still be transparent. It has been found that if the agent is about 2.0 wt% or less of the screen material and the ceramic zeolite particles are of 1.0 micron or smaller in size, that requirement for transparency can be met. Also, even though in the preferred embodiment the agent comprises ceramic particles having a metal component, the electrical properties of the touch screen will not be seriously adversely affected, whether the screen is of the resistive, capacitive or of another type.

A preferred embodiment according to the invention of a screen made from a resin that contains the zeolite particles has:

resin of screen	polycarbonate
antimicrobial agent	AJ10D (Shinigawa)
agent particles/size	1.0 micron
Final wt% of agent in resin used for the screen	2.0%

When the desired resin for the touch screen outer layer is in liquid form, the zeolite ceramic particles are mixed with the liquid resin. The mixing is thorough to uniformly disperse the zeolite particles. A liquid mixture of the zeolite particles and the resin is obtained. The mixing should be thorough to uniformly disperse the zeolite particles. Here also, in a preferred embodiment, the zeolite particles are preferably present in the range of 0.5 to 2.0 wt% of the liquid resin and are of 1.0 micron size or smaller. The liquid resin containing the particles is processed in a conventional manner, such as by casting, molding or extension, to form the screen rigid outer layer.

Agent is incorporated in deformable outer layer.

The touch screen 20 outer layer 22 of Fig.2 also is of a plastic resin material but this is deformable. That is, the plastic resin has elastomeric properties and is relatively transparent. A suitable material is clear silicone rubber. Other suitable elastomeric materials can be used.

In this embodiment the agent particles are mixed into the elastomeric material in the desired amount and the mixture is extruded in sheet form of the desired thickness in the conventional manner. The sheet containing the inorganic agent particles is cut to the desired size and incorporated into the touch screen as the normal screen outer layer 22. The agent particles are present throughout the entire surface of the outer layer 22 that is to be touched and depressed. Thus, the desired antimicrobial action is achieved.

In a preferred embodiment of a deformable outer layer for the touch screen:

resin of screen	clear silicone rubber
antimicrobial agent	AJ10D (Shinigawa) silver zeolite
agent particles/size	1.0 micron
Final wt% of agent in resin used for the screen	5.0%

The thickness of the layer 22 can be substantially the same as for deformable layers of the same material that do not contain the agent

Coating the outer layer exposed surface.

In this embodiment, such as illustrated in Fig. 3, the touch screen outermost part is a plate 32 of glass or other rigid material that is formed in the normal manner of the desired material and process. After its formation, a coating containing the agent is applied to the outer surface of the touch screen outer plate 32. Polymer coatings of transparent material are preferred for this embodiment. The coating preferably can be of, for example, a hydrophilic polymer such as hydrophilic polyurethane, or an acrylic, both of which are transparent.

To make the coating material, particles containing the antimicrobial agent are mixed with the resin in the desired amount. Here also, the amount of the agent particles is such that the transparency of the coating will not be adversely affected and its application will not adversely affect the screen electrical properties. Here the percentage of the ceramic zeolite particles, when used, by total weight of the coating is from about 1.0 to 90.0 wt%, more preferably from about 1.0 to 65.0 wt% and most preferably from about 5.0 to 45.0 wt%, and the size of the agent particles also preferably is less than 5.0 microns.

The coating with the agent is applied to the screen outer layer outer surface by any suitable technique, such as dipping, spraying or painting. The agent is available in the coating on the outer surface to be touched by the finger to perform its antimicrobial action.

A typical embodiment of the coating is:

coating material	acrylic
agent	AJ10D (Shinigawa) silver zeolite
agent particle size	1.0 micron
wt% of agent particles	15.0

in coating	
thickness of coating	3 mils

Outer layer is a laminate containing the agent

Here, as illustrated in Fig. 4, the outermost part of the touch screen 40 is a plate 32 of rigid material, such as glass or a suitable resin. Here, a laminate layer 44 forms the outer layer of the touch screen. The laminate layer is a sheet of transparent material formed in the same manner previously described of either a plate of resin containing the agent, such as would be used for the outer layer 12 of Fig. 1, or of deformable elastomeric material containing the agent, such as for the outer deformable layer 22 of Fig. 2.

The sheet for layer 44 is made to the appropriate size and thickness. It is bonded to the outer surface of the plate 32 by any suitable process compatible with the material of the layer, such as an adhesive, ultrasonic welding, heat bonding, as a laminated outer layer. Since the agent particles are present throughout the entirety of the laminate layer 44, they will be present on the layer outer surface that is touched to perform the desired antimicrobial action.

A typical embodiment for the laminate layer 44:

laminate material	silicone rubber
agent	AJ10D (Shinigawa) silver zeolite
agent particle size	1.0 micron
wt% of agent particles in laminate	2.0
thickness of laminate	25.0 microns

Inorganic Agent.

Preferred inorganic antimicrobial agents incorporated in the resin or used in the coating use metal ions (cations), such as mercury, tin, lead, bismuth, cadmium, chromium and thallium ions, as the active agent. These antibiotic or antimicrobial metal ions are believed to exert their effects by disrupting respiration and electron transport systems upon absorption into bacterial or fungal cells. Antimicrobial metal ions (cations) of silver, gold, copper and zinc, in particular, are considered safe even for *in vivo* use. Antimicrobial silver ions are particularly useful for *in vivo* use due to the fact that they are not substantially absorbed into the body. That is, if such materials are used they should pose no hazard.

In one embodiment of the invention, the inorganic antimicrobial metal containing composition is an antibiotic metal salt. Such salts include silver acetate, silver benzoate, silver carbonate, silver ionate, silver iodide, silver lactate, silver laureate, silver nitrate, silver oxide, silver palpitate, silver protein, and silver sulfadiazine. Silver nitrate is preferred. These salts are particularly quick acting, as no release from ceramic particles is necessary to function antimicrobially.

Ceramic particles, including particles comprising silver, copper or zinc ions, have been shown to possess antimicrobial or antibiotic activity. These particles involve slow release of the antibiotic metal, such as silver, from the zeolite particles. This is suitable for the resin forming the screen outer layer or for the coating and laminate materials.

Antimicrobial ceramic particles useful with the present invention include zeolites, hydroxy apatite, zirconium phosphates or other ion-exchange ceramics. Zeolites are preferred. Hydroxy apatite particles containing antimicrobial metals are described, e.g., in U.S. Patent No. 5,009,898. Zirconium phosphates containing antimicrobial metals are described, e.g., in U.S. Patent Nos. 5,296,238; 5,441,717; and 5,405,644.

Other suitable antimicrobial agents include inorganic particles, such as the oxides of titanium, aluminum, zinc and copper, which may be coated with a composition which confers antimicrobial properties, for example, by releasing antimicrobial metal ions such as silver ions, which are described, e.g., in U.S. Patent No. 5,890,585. Inorganic soluble glass particles containing antimicrobial metal ions, such as silver, are described, e.g., in U.S. Patent Nos. 5,766,611 and 5,290,544.

Antibiotic or antimicrobial zeolites are preferred. These have been prepared by replacing all or part of the ion-exchangeable ions in zeolite with ammonium ions and antimicrobial metal ions, as described in U.S. Patent Nos. 4,938,958 and 4,911,898. Such zeolites have been incorporated in antimicrobial resins (as shown in U.S. Patent Nos. 4,938,955 and 4,906,464) and polymer articles (U.S. Patent No. 4,775,585). Polymers including the antimicrobial zeolites have been used to make refrigerators, dish washers, rice cookers, plastic film, vacuum bottles, plastic pails, and garbage containers. Other materials in which antimicrobial zeolites have been incorporated include flooring, wall paper, cloth, paint, napkins, plastic automobile parts, bicycles, pens, toys, sand, and concrete. Examples of such uses are described in U.S. Patents 5,714,445; 5,697,203; 5,562,872; 5,180,585; 5,714,430; and 5,102,401.

Either natural zeolites or synthetic zeolites can be used to make the antibiotic zeolites used in the present invention. "Zeolite" is an aluminosilicate having a three dimensional skeletal structure that is represented by the formula: $XM_{2/n}O \bullet Al_2O_3 \bullet YSiO_2 \bullet ZH_2O$. M represents an ion-exchangeable ion, generally a monovalent or divalent metal ion, n represents the atomic valency of the (metal) ion, X and Y represent coefficients of metal oxide and silica respectively, and Z represents the number of waters of crystallization. Examples of such zeolites include A-type zeolites, X-type zeolites, Y-type zeolites, T-type zeolites, high-silica zeolites, sodalite, mordenite, analcite,

clinoptilolite, chabazite and erionite. The present invention is not restricted to use of these specific zeolites.

The ion-exchange capacities of these zeolites are as follows: A-type zeolite = 7 meq/g; X-type zeolite = 6.4 meq/g; Y-type zeolite = 5 meq/g; T-type zeolite = 3.4 meq/g; sodalite = 11.5 meq/g; mordenite = 2.6 meq/g; analcite = 5 meq/g; clinoptilolite = 2.6 meq/g; chabazite = 5 meq/g; and erionite = 3.8 meq/g. These ion-exchange capacities are sufficient for the zeolites to undergo ion-exchange with ammonium and antimicrobial metal ions.

The specific surface area of preferred zeolite particles is preferably at least 150 m^2/g (anhydrous zeolite as standard) and the SiO_2/Al_2O_3 mol ratio in the zeolite composition is preferably less than 14, more preferably less than 11.

The antimicrobial or antibiotic metal ions (cations) used in the antibiotic zeolites should be retained on the zeolite particles through an ion-exchange reaction. Antibiotic metal ions which are adsorbed or attached without an ion-exchange reaction exhibit a decreased bactericidal effect and their antibiotic effect is not long-lasting. Nevertheless, it is advantageous for imparting quick antimicrobial action to maintain a sufficient amount of surface adsorbed metal ion.

In the ion-exchange process, the antimicrobial metal ions (cations) tend to be converted into their oxides, hydroxides, basic salts etc. either in the microforms or on the surfaces of the zeolite and also tend to deposit there, particularly when the concentration of metal ions in the vicinity of the zeolite surface is high. Such deposition tends to adversely affect the bactericidal properties of ion-exchanged zeolite.

In an embodiment of the antimicrobial zeolite, a relatively low degree of ion exchange is employed to obtain superior bactericidal properties. It is believed to be required that at least a portion of the zeolite particles retain metal ions (cations) having bactericidal properties at ion-exchangeable sites of the zeolite in an amount less than the ion-exchange saturation capacity of the zeolite. In one embodiment, the zeolite employed in the present invention retains antimicrobial metal ions in an amount up to 41% of the theoretical ion-exchange capacity of the zeolite. Such ion-exchanged zeolite with a relatively low degree of ion-exchange may be prepared by performing ion-exchange using a metal ion solution having a low concentration as compared with solutions conventionally used for ion exchange.

The zeolite preferably comprises an integral discoloration agent such as ion-exchanged ammonium. Although ammonium ions may be contained in the zeolite at a concentration as high as about 20% by weight of the zeolite, it is desirable to limit the content of ammonium ions to about 0.5 to about 2.5%, more preferably from about 0.5 to about 2.0%, and most preferably, from about 0.5 to about 1.5% by weight of the zeolite.

In the antimicrobial zeolite particles used in the present invention, ion-exchangeable ions (cations) present in zeolite, such as sodium ions, calcium ions, potassium ions and iron ions are partially replaced with antimicrobial metal ions, such as silver. The antimicrobial zeolite typically comprises from about 0.5 to about 15% and preferably from about 0.5 to about 2% by weight of ion-exchanged silver based upon 100% total weight of zeolite. Other antimicrobial metal ions may be included in the zeolite such as copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, thallium, or a combination thereof. Such ions may co-exist in the antimicrobial zeolite particles since they do not prevent the bacterial effect of the zeolite particles. These antimicrobial metal ions may be incorporated into the zeolite by themselves or in a mixture. In one embodiment, the zeolite

contains from about 0.1 to about 15% by weight of silver ions and from about 0.1 to about 8% by weight of copper or zinc ions.

The antimicrobial or antibiotic metal ion is preferably present in the range of from about 0.1 to 20wt.% of the zeolite. In one embodiment, the zeolite contain from 0.1 to 20wt.% of silver ions and from 0.1 to 20wt.% of copper or zinc ions. Although ammonium ions can be contained in the zeolite at a concentration of about 20 wt.% or less of the zeolite, it is desirable to limit the content of ammonium ions to from 0.5 to 15 wt.%, preferably 1.5 to 5 wt.%. Weight% described herein is determined for materials dried at temperatures such as 110°C, 250°C or 550°C as this is the temperature employed for the preferred post-manufacturing drying process.

A preferred antimicrobial zeolite is type A zeolite containing either a combination of ion-exchanged silver, zinc, and ammonium or silver and ammonium. One such zeolite is manufactured by Shinagawa, Inc. under the product number AW-10N and consists of 0.6% by weight of silver ion-exchanged in Type A zeolite particles having a diameter of about 2.5μ. Another formulation, AJ-10N, consists of about 2% by weight silver ion-exchanged in Type A zeolite particles having a diameter of about 2.5μ. Another formulation, AW-80, contains 0.6% by weight of silver ion-exchanged in Type A zeolite particles having a diameter of about 1.0μ. Another formulation, AJ-80N, consists of about 2% by weight silver ion-exchanged in Type A zeolite particles having a diameter of about 1.0μ. These zeolites preferably contain about between 0.5% and 2.5% by weight of ion-exchanged ammonium. A further product is AJ1OD, which consists of about 2% by weight of silver ion exchanged in Type A zeolite particles having a diameter of about 1.0μ.

The zeolite are often obtained in master batches of low density polyethylene, polypropylene, or polystyrene, containing 20 wt% of the zeolite. Thus, they can be easily mixed with the resins used as materials for forming the foam.

The antimicrobial properties of the antimicrobial zeolite particles of the invention may be assayed while in aqueous formulations using conventional assay techniques, including for example determining the minimum growth inhibitory concentration (MIC) with respect to a variety of bacteria, Eumycetes and yeast. In such a test, the bacteria listed below may be employed:

Bacillus cereus varmycoides;
Escherichia coli;
Pseudomonas aeruginosa;
Staphylococcus aureus;
Streptococcus faecalis;
Aspergillus niger;
Aureobasiduim pullulans;
Chaetomium globosum;
Gliocladium virens;
Penicillum funiculosum;
Candida albicans; and
Saccharomyces cerevisiae.

The assay for determining MIC can be carried out by smearing a solution containing bacteria for inoculation onto a plate culture medium to which a test sample of the encapsulated antibiotic zeolite particles is added in a particular concentration, followed by incubation and culturing of the plate. The MIC is defined as a minimum concentration thereof required for inhibiting the growth of each bacteria.

Safety and biocompatibility tests were conducted on the antibiotic zeolite employed in the invention. ISO 10993-1 procedures were employed. The following results were obtained:

Cytotoxicity: **Non-Toxic**
Acute Systemic Toxicity: **Non-Toxic**
Oral Toxicity: Safer than table salt
Intracutaneous Toxicity: **Passed**
Skin Irritation Test: **Non-Irritant**
Chronic Toxicity: **No Observable Effect**
In-vitro Hemolysis: **Non-Hemolytic**
30-day Muscle Implant Test: **Passed**
60-day Muscle Implant Test: **Passed**
90-day Muscle Implant Test: **Passed**
Ames Mutagenicity Test: **Passed**
Pyrogenicity: **Non-Pyrogenic**

Thus, the antibiotic zeolite are exceptionally suitable under relevant toxicity and biocompatibility standards for use in the outer screen layer, coatings and laminates.

Specific features of the invention are shown in one or more of the drawings for convenience only, as each feature may be combined with other features in accordance with the invention. Alternative embodiments will be recognized by those skilled in the art and are intended to be included within the scope of the claims. Accordingly, the above description should be construed as illustrating and not limiting the scope of the invention.

WE CLAIM:

1. A touch screen for computer input, said screen having an outer surface to be contacted by touching, said screen comprising an inorganic antimicrobial agent in sufficient amount to impart a significant antimicrobial effect to said outer surface.

2. The touch screen of claim 1, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

3. The touch screen of claim 2 wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

4. The touch screen of claim 1, wherein said touch screen is transparent.

5. A touch screen for computer input, said screen having an outer surface to be contacted by touching, wherein said screen comprises a plastic resin comprising an inorganic antimicrobial agent in sufficient amount to impart a significant antimicrobial effect to said outer surface.

6. The touch screen of claim 5, wherein said plastic resin is an elastomer.

7. The touch screen of claim 5, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

8. The touch screen of claim 7, wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

9. The touch screen of claim 8, wherein said zeolite particles are present in an amount of from 0.1 to 20.0 wt% of the total weight of said plastic resin material.

10. The touch screen of claim 9, wherein said zeolite particles are present in an amount of about 2.0 wt% and a particle size of about 1.0 micron.

11. The touch screen of claim 5, wherein said touch screen is transparent.

12. A touch screen for computer input, said screen having an outer surface to be contacted by touching, wherein said outer surface of said touch screen comprises a polymeric coating, and said inorganic antimicrobial agent is present in said polymeric coating in sufficient amount to impart a significant antimicrobial effect to said outer surface.

13. The touch screen of claim 12, wherein said polymeric coating comprises a polymer selected from the group consisting of polyurethane or an acrylic polymer.

14. The touch screen of claim 12, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

15. The touch screen of claim 14, wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

16. The touch screen of claim 15, wherein said zeolite particles are present in an amount by total weight of said polymeric coating of from about 5.0 to 45.0 wt%, and said zeolite particles have a particle size of less than 5.0 microns.

17. The touch screen of claim 12, wherein said polymeric coating is a laminate layer comprising said inorganic antimicrobial agent.

18. The touch screen of claim 17, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

19. The touch screen of claim 18, wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

20. The touch screen of claim 12, wherein said touch screen is transparent.

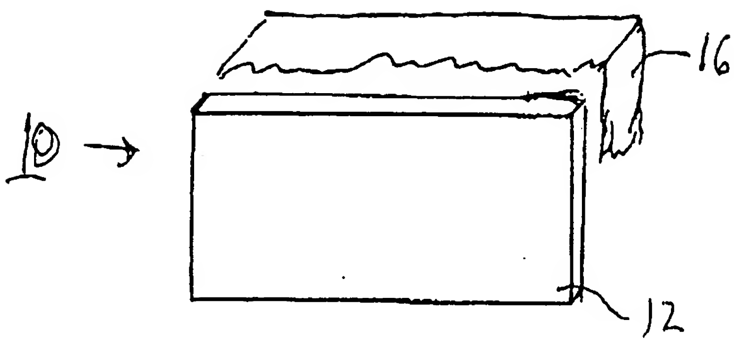


FIG. 1

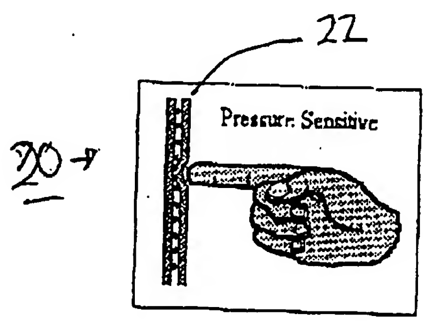


FIG. 2

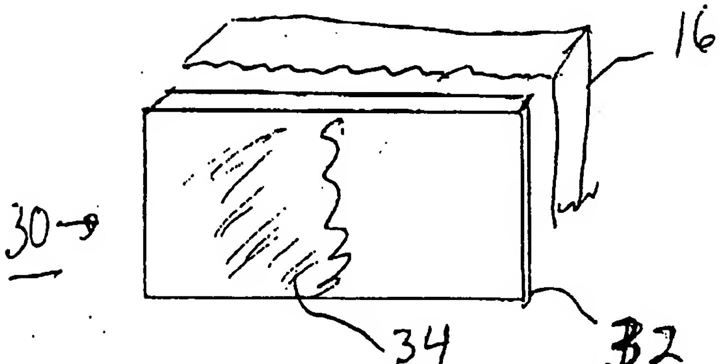


FIG. 3

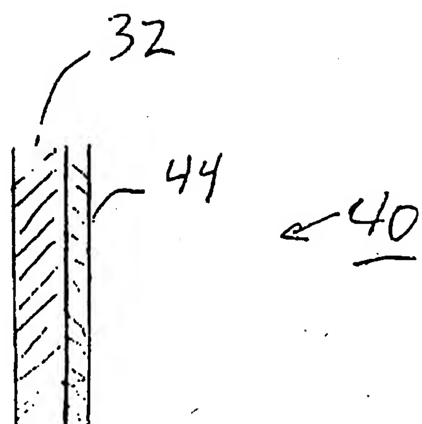


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/35018

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06K11/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06K G06F C04B C09D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 942 351 A (DAICEL CHEMICAL INDUSTRIES, LTD.) 15 September 1999 (1999-09-15) page 2, line 26 -page 3, line 58	1-4, 12-15, 17-20
A	page 6, line 4 - line 11; figure 2	5-9,11
P,A	WO 00 43831 A (MICROTOUCH SYSTEMS INC.) 27 July 2000 (2000-07-27) page 6, line 11 -page 7, line 14; claims 1-9; figures 1,2	1,4-6, 11,12, 17,20
A	DE 198 18 970 A (SAMSUNG DISPLAY DEVICES CO. LTD.) 12 November 1998 (1998-11-12) column 2, line 10 -column 3, line 23 column 3, line 67 -column 4, line 3	1,2,4, 12,17, 18,20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2001	27/04/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Taylor, P

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte   'onal Application No
PCT/US 00/35018

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 942351	A	15-09-1999	JP 11110133	A	23-04-1999
			WO 9917188	A	08-04-1999
WO 0043831	A	27-07-2000	AU 2399000	A	07-08-2000
DE 19818970	A	12-11-1998	CN 1199240	A	18-11-1998
			JP 2000011921	A	14-01-2000

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 June 2001 (28.06.2001)

PCT

(10) International Publication Number
WO 01/046900 A1

(51) International Patent Classification[7]: G06K 11/08

(21) International Application Number: PCT/US00/35018

(22) International Filing Date: 21 December 2000 (21.12.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/469,634 22 December 1999 (22.12.1999) US

(71) Applicant (*for all designated States except US*): **AGION TECHNOLOGIES, LLC** [US/US]; Welch, Ed, 60 Audubon Road, Wakefield, MA 01880 (US).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **TROGOLO, Jeffrey** [US/US]; 228 Commonwealth Avenue, Boston, MA 02116 (US). **FRIEDMAN, Roger** [US/US]; One Governors Row, West Hartford, CT 06116 (US). **BARRY, John** [US/US]; 18 Drake Lane, Derry, NH 03038 (US).

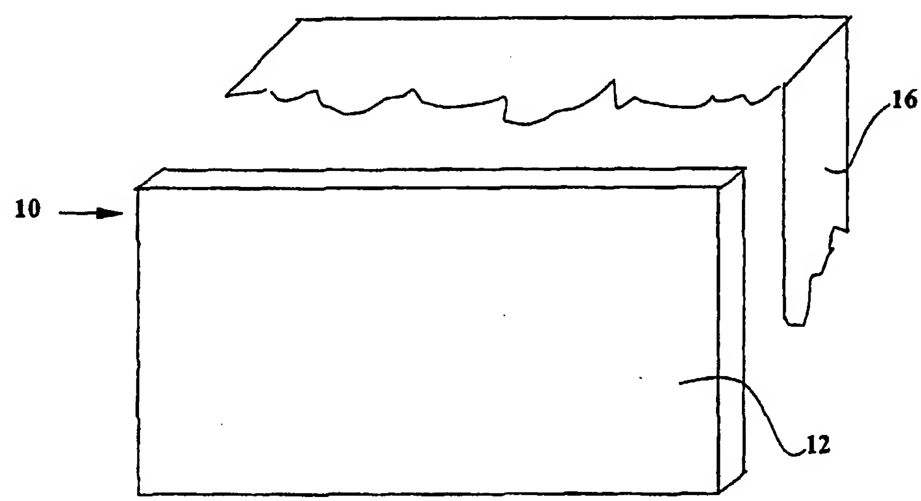
(74) Agent: **HULTQUIST, Steven, J.**; Intellectual Property/Technology Law, 6320 Quadrangle Drive, Suite 110, Chapel Hill, NC 27514 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: TOUCH SCREEN WITH ANTIMICROBIAL PROPERTIES



(57) **Abstract:** A touch screen for computer input having an outer surface that is to be touched by a user containing an inorganic antimicrobial agent. The agent, which can be a zeolite, is present at the surface in an effective amount to kill or retard growth of bacteria. The agent can be incorporated in a plastic resin forming the layer of the touch screen that includes the outer surface, contained in a coating applied to the outer layer of the touch screen, or contained in a laminate that is applied to the touch screen outer layer.

WO 01/046900 A1

WO 01/046900 A1

Published:
— *with international search report*

(48) Date of publication of this corrected version:
18 July 2002

(15) Information about Correction:
see PCT Gazette No. 29/2002 of 18 July 2002, Section II

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TOUCH SCREEN WITH ANTIMICROBIAL PROPERTIES

Field of the Invention

The present invention relates to touch-type screens used with computers having antimicrobial properties.

Background of the Invention

Touch-type screens or touch screens are used in computer applications for input of data, such as in automatic teller machines, cash registers, inventory control devices, kiosks to provide information, restaurants for food order entry, gaming systems, industrial control applications, telephone number entry, and for general purpose computer data input. Such screens for inputting data are available in add-on form to be associated with an exiting video display device or are integrated as part of a display device. The screens are associated with a display of data to be entered into computers. The data can appear on the display device with which the touch screen is associated or as a printed graphic display that is part of the touch screen.

The touch screens, whether of the add-on or integrated type, utilize a variety of technologies. They all include an outer layer whose outer surface is to be touched at a location to input the desired data and various other components, such as additional underlying layers and electronic components. In resistive touch screens, finger pressure on specific areas of a deformable outer transparent screen layer completes a circuit to send a message to the computer for processing. Another type of screen uses strain gauges that react to pressure on a relatively rigid screen outer layer to measure the point at which pressure is applied to the outer layer. In a micro-wire type touch screen, each area on the screen is micro-wired as a grid with unique circuit characteristics whereby the particular point of the screen outer layer that is touched is identifiable.

Other touch screens include those of the capacitive type in which a finger touches the desired area on a rigid outer layer of electrical insulating material, such as glass or a plastic resin, for data input. The capacitive properties of the finger draws current to the point touched, which is then registered by the system.

In another type of touch screen, surface acoustic wave sensors (SAWs) transmit waves across a rigid screen, such as a screen having a glass outer layer. When the outer layer is touched, a disturbance is created in the wave pattern which allows the system to determine the area being touched.

IR (infra red) touch screens operate with beams of IR energy in a grid form projected across a screen outer layer. The beams are broken by the finger placement to determine a signal position.

Piezoelectric and optical type touch screens also are used.

In common to all of the above types of touch screens, and other types, is the fact that the exposed surface of the screen outer layer is touched by the fingers of a human. Since a number of people can touch any given screen, a problem exists of possible transfer of bacteria. That is, one person having unsanitary hands can touch a screen and leave a residue of bacteria. The next person touching the same part of the screen can pick up the bacteria and transfer it to his own body parts or transfer bacteria to others during normal body contact.

If the bacteria left on the screen is of a strain that can produce a harmful medical condition, the next and subsequent persons touching the screen possibly could be adversely affected by contact with the bacteria. Therefore, it would be desirable to maintain the screen in a sanitary condition, as free

of bacteria as possible, at all times. While the screen can be wiped with a liquid antiseptic solution to kill bacteria, this can only be done periodically. Also, a liquid antiseptic is not a long-lasting solution to the problem since the liquid will evaporate. Therefore, a need exits for a touch screen whose outer layer that is to be touched is provided with antimicrobial action that is continuous and long lasting.

Brief Description of the Invention

The present invention is directed to a touch screen associated with a computer, as an add on to a display device or which is an integral part of the device, wherein the screen has antimicrobial properties. In accordance with the invention, the touch screen which is to be touched by the user's finger comprises an inorganic antimicrobial agent in sufficient amount to impart a significant antimicrobial effect to the outer surface of the touch screen. The agent is present in an amount that is effective to kill, or reduce the growth of, bacteria while still leaving the screen transparent and operative for use by touch. In a preferred embodiment, the inorganic antimicrobial agent is ceramic particles comprising antimicrobial metal ions (e.g., zeolites), preferably of ceramic particles in an amount and of a type that does not adversely affect the screen transparency or electrical properties.

The agent can be incorporated in the resin forming the screen outer layer, or provided as a laminate or coating applied on the outermost screen layer. The agent is available over the entire surface area of the screen outer layer that is to be touched by the finger. The inorganic agent remains active over a long period of time.

Objects of the Invention

It is therefore an object of the invention to provide a touch screen that has antimicrobial properties for an input device associated with a computer.

A further object is to provide a touch type screen whose outer layer outer surface contains an inorganic antimicrobial agent.

Yet another object is to provide a touch screen in which the surface that is to be touched by a user's finger incorporates a zeolite to provide antimicrobial properties.

An additional object is to provide a touch screen in which an inorganic antimicrobial agent is incorporated in the material forming the screen outermost layer, is applied as a laminate to such outer layer or is coated onto the layer.

Brief Description of the Drawings

Other objects and advantages of the present invention will become more apparent upon reference to the following specification and annexed drawings in which:

Fig. 1 is a diagrammatic view of a type of touch screen having an outer layer that is rigid;

Fig. 2 is a diagrammatic cross-sectional view of a touch screen whose outer layer is of a deformable material;

Fig. 3 is a diagrammatic view of a touch screen in which a coating is applied to the outer layer; and

Fig. 4 is a diagrammatic cross-sectional view of a touch screen in which a laminate containing the antimicrobial agent is applied to the screen outer layer.

Detailed Description of the Invention

For all of the embodiments of the invention, a preferred antimicrobial agent is an agent comprising ceramic particles containing antimicrobial metal ions, such as a zeolite subject to ion exchange with antimicrobial metal ions, such as silver ions. Suitable zeolites are generally disclosed in U.S. Patents 4,938,955 and 4,906,464.

In the preferred embodiment of the invention, the inorganic antimicrobial agent is ceramic silver zeolite particles, such as AJ10D, made by Shinagawa Company of Osaka, Japan, and which are of a nominal 1.0 micron size.

The antimicrobial agent is present in an effective amount to impart antimicrobial properties to the screen surface to be touched by the user.

The amount of the antimicrobial agent will vary based on the specific inorganic agent used, its composition, the material with which it is mixed or added to, and upon known factors such as type and use of the product containing the agent. Environmental factors, such as the temperature of the environment where the touch screen is located and of any associated electronic components, also should be taken into consideration. It is within the ability of one skilled in the art to in view of this disclosure to relatively easily determine an effective amount of the antimicrobial agent to be used with each material.

Since the particle size of the agent is small, preferably 1.0 micron or less, incorporation into the screen outer layer material will not adversely affect the transparency needed for the touch screen if the amount of antimicrobial agent is not excessive.

Fig. 1 is a diagrammatic view showing the general principles of one type of touch screen 10. This is used for illustrative purposes. The invention is applicable to all of the foregoing types of touch screens discussed, and others. Here, the screen 10 has a rigid outer layer 12 of a plastic material, for example a polycarbonate such as sold under the name LEXAN. The touch screen outer layer 12 is of a desired thickness and is associated with a number of other components generally designated by reference numeral 16. For example, if the touch screen is of the IR type, there would be optoelectronic members, such as mounted in a bezel, around the perimeter of the outer layer 12, and various electronic components. The details of the other parts of the touch screen are conventional and are not critical to the subject invention. In the touch screen 10 of Fig. 1 the invention provides the antimicrobial agent on the entire outer surface of outer layer 12.

In Fig. 2, the touch screen 20 illustratively is of the pressure sensitive type. Here, the outer layer 22 is of a transparent elastomeric polymeric material having the agent available on the outer surface that is contacted and pressed by the user's finger. Fig. 2 is illustrative, for example, of a resistive, micro-grid or piezoelectric type of touch screen.

In Fig. 3, the outermost part of the touch screen 30 is a rigid plate 32 of transparent material such as a plastic resin or glass. Here, there is a transparent coating 34 as the outer layer that contains the inorganic antimicrobial agent. Fig. 3 is illustrative, for example, of a portion of a capacitive or strain gauge type of touch screen.

Fig. 4 shows a touch screen 40 whose outermost part also is a transparent plate 32 of glass or plastic resin. Here, a transparent laminate layer 44 containing the agent is bonded to the plate 32 as the outer layer containing the agent. Fig. 4 also is illustrative of a capacitive or strain gauge type of touch screen.

In accordance with the invention, the transparent outer layer of the touch screen of the types described above or of any other type that is to be touched by the user's finger is to be provided with antimicrobial properties. To accomplish this, the antimicrobial agent is to be present on the surface of the screen outer layer that is to be touched by the finger. Provision of the agent for the various screen configurations is described below.

Antimicrobial Agent is incorporated in a resin rigid outer layer. One type of outer layer of the touch screen, such as shown in Fig. 1, is made of a resin material, such as a polycarbonate. One such well-known type of this material is sold under the name LEXAN. For a touch screen whose outer layer is of a plastic resin material, the agent is preferably incorporated into the resin from which such layer is made.

The resins into which the zeolite is incorporated can be those such as polyurethane, polyethylene, polypropylene, polystyrene, polyvinyl chloride, polycarbonates and others as disclosed in said patents. Methods of zeolite incorporation are disclosed in the foregoing U.S. Patents 4,938,955 and 4,906,464.

The ceramic silver zeolite particles of the preferred embodiment can be incorporated, such as by kneading, into the resin for the screen layer and the layer formed in its normal manner, such as by molding, casting or extrusion.

The ceramic particles are mixed with the resin in the manner described in the aforesaid patents. The concentration of the particles of the agent is preferably in the range of from 0.1 to 20.0 wt%, more preferably from 0.1 to 10.0 wt%, and most preferably from 0.5 to 5.0 wt% of the total weight of the resin forming the screen outer layer.

The inorganic antimicrobial agent in the form of the zeolite particles is available throughout the entirety of the screen outer layer, including the entire outer surface that is to be touched by the user, to perform its antimicrobial action. The agent kills or reduces the growth of bacteria on such surface.

In general, the antibiotic particles are preferably present in an effective amount in a concentration by weight in the resin used to form the screen layer to impart antimicrobial properties to the screen layer. This means that there is a sufficient amount of the antimicrobial agent added to or combined with other materials, such as resin to form the layer, so as to be present on the exposed surface to prevent or inhibit the growth of bacterial and/or fungal organisms or to kill such organisms. This is within the skill of the art in light of the present specification.

It is preferred that the final amount of the zeolite particles be in the range of from about 0.5 to 2.0% of the total weight of the resin for the screen layer so that it will still be transparent. It has been found that if the agent is about 2.0 wt% or less of the screen material and the ceramic zeolite particles are of 1.0 micron or smaller in size, that requirement for transparency can be met. Also, even though in the preferred embodiment the agent comprises ceramic particles having a metal component, the electrical properties of the touch screen will not be seriously adversely affected, whether the screen is of the resistive, capacitive or of another type.

A preferred embodiment according to the invention of a screen made from a resin that contains the zeolite particles has:

resin of screen	polycarbonate
antimicrobial agent	AJ10D (Shinigawa)
agent particles/size	1.0 micron
Final wt% of agent in resin used for the screen	2.0%

When the desired resin for the touch screen outer layer is in liquid form, the zeolite ceramic particles are mixed with the liquid resin. The mixing is thorough to uniformly disperse the zeolite particles. A liquid mixture of the zeolite particles and the resin is obtained. The mixing should be thorough to uniformly disperse the zeolite particles. Here also, in a preferred embodiment, the zeolite particles are preferably present in the range of 0.5 to 2.0 wt% of the liquid resin and are of 1.0 micron size or smaller. The liquid resin containing the particles is processed in a conventional manner, such as by casting, molding or extension, to form the screen rigid outer layer.

Agent is incorporated in deformable outer layer.

The touch screen 20 outer layer 22 of Fig.2 also is of a plastic resin material but this is deformable. That is, the plastic resin has elastomeric properties and is relatively transparent. A suitable material is clear silicone rubber. Other suitable elastomeric materials can be used.

In this embodiment the agent particles are mixed into the elastomeric material in the desired amount and the mixture is extruded in sheet form of the desired thickness in the conventional manner. The sheet containing the inorganic agent particles is cut to the desired size and incorporated into the touch screen as the normal screen outer layer 22. The agent particles are present throughout the entire surface of the outer layer 22 that is to be touched and depressed. Thus, the desired antimicrobial action is achieved.

In a preferred embodiment of a deformable outer layer for the touch screen:

resin of screen	clear silicone rubber
antimicrobial agent	AJ10D (Shinigawa) silver zeolite
agent particles/size	1.0 micron
Final wt% of agent in resin used for the screen	5.0%

The thickness of the layer 22 can be substantially the same as for deformable layers of the same material that do not contain the agent

Coating the outer layer exposed surface.

In this embodiment, such as illustrated in Fig. 3, the touch screen outermost part is a plate 32 of glass or other rigid material that is formed in the normal manner of the desired material and process. After its formation, a coating containing the agent is applied to the outer surface of the touch screen outer plate 32. Polymer coatings of transparent material are preferred for this embodiment. The coating preferably can be of, for example, a hydrophilic polymer such as hydrophilic polyurethane, or an acrylic, both of which are transparent.

To make the coating material, particles containing the antimicrobial agent are mixed with the resin in the desired amount. Here also, the amount of the agent particles is such that the transparency of the coating will not be adversely affected and its application will not adversely affect the screen electrical properties. Here the percentage of the ceramic zeolite particles, when used, by total weight of the coating is from about 1.0 to 90.0 wt%, more preferably from about 1.0 to 65.0 wt% and most preferably from about 5.0 to 45.0 wt%, and the size of the agent particles also preferably is less than 5.0 microns.

The coating with the agent is applied to the screen outer layer outer surface by any suitable technique, such as dipping, spraying or painting. The agent is available in the coating on the outer surface to be touched by the finger to perform its antimicrobial action.

A typical embodiment of the coating is:

coating material	acrylic
agent	AJ10D (Shinigawa) silver zeolite
agent particle size	1.0 micron
wt% of agent particles	15.0

in coating	
thickness of coating	3 mils

Outer layer is a laminate containing the agent

Here, as illustrated in Fig. 4, the outermost part of the touch screen 40 is a plate 32 of rigid material, such as glass or a suitable resin. Here, a laminate layer 44 forms the outer layer of the touch screen. The laminate layer is a sheet of transparent material formed in the same manner previously described of either a plate of resin containing the agent, such as would be used for the outer layer 12 of Fig. 1, or of deformable elastomeric material containing the agent, such as for the outer deformable layer 22 of Fig. 2.

The sheet for layer 44 is made to the appropriate size and thickness. It is bonded to the outer surface of the plate 32 by any suitable process compatible with the material of the layer, such as an adhesive, ultrasonic welding, heat bonding, as a laminated outer layer. Since the agent particles are present throughout the entirety of the laminate layer 44, they will be present on the layer outer surface that is touched to perform the desired antimicrobial action.

A typical embodiment for the laminate layer 44:

laminate material	silicone rubber
agent	AJ10D (Shinigawa) silver zeolite
agent particle size	1.0 micron
wt% of agent particles in laminate	2.0
thickness of laminate	25.0 microns

Inorganic Agent.

Preferred inorganic antimicrobial agents incorporated in the resin or used in the coating use metal ions (cations), such as mercury, tin, lead, bismuth, cadmium, chromium and thallium ions, as the active agent. These antibiotic or antimicrobial metal ions are believed to exert their effects by disrupting respiration and electron transport systems upon absorption into bacterial or fungal cells. Antimicrobial metal ions (cations) of silver, gold, copper and zinc, in particular, are considered safe even for *in vivo* use. Antimicrobial silver ions are particularly useful for *in vivo* use due to the fact that they are not substantially absorbed into the body. That is, if such materials are used they should pose no hazard.

In one embodiment of the invention, the inorganic antimicrobial metal containing composition is an antibiotic metal salt. Such salts include silver acetate, silver benzoate, silver carbonate, silver ionate, silver iodide, silver lactate, silver laureate, silver nitrate, silver oxide, silver palpitate, silver protein, and silver sulfadiazine. Silver nitrate is preferred. These salts are particularly quick acting, as no release from ceramic particles is necessary to function antimicrobially.

Ceramic particles, including particles comprising silver, copper or zinc ions, have been shown to possess antimicrobial or antibiotic activity. These particles involve slow release of the antibiotic metal, such as silver, from the zeolite particles. This is suitable for the resin forming the screen outer layer or for the coating and laminate materials.

Antimicrobial ceramic particles useful with the present invention include zeolites, hydroxy apatite, zirconium phosphates or other ion-exchange ceramics. Zeolites are preferred. Hydroxy apatite particles containing antimicrobial metals are described, e.g., in U.S. Patent No. 5,009,898. Zirconium phosphates containing antimicrobial metals are described, e.g., in U.S. Patent Nos. 5,296,238; 5,441,717; and 5,405,644.

Other suitable antimicrobial agents include inorganic particles, such as the oxides of titanium, aluminum, zinc and copper, which may be coated with a composition which confers antimicrobial properties, for example, by releasing antimicrobial metal ions such as silver ions, which are described, e.g., in U.S. Patent No. 5,890,585. Inorganic soluble glass particles containing antimicrobial metal ions, such as silver, are described, e.g., in U.S. Patent Nos. 5,766,611 and 5,290,544.

Antibiotic or antimicrobial zeolites are preferred. These have been prepared by replacing all or part of the ion-exchangeable ions in zeolite with ammonium ions and antimicrobial metal ions, as described in U.S. Patent Nos. 4,938,958 and 4,911,898. Such zeolites have been incorporated in antimicrobial resins (as shown in U.S. Patent Nos. 4,938,955 and 4,906,464) and polymer articles (U.S. Patent No. 4,775,585). Polymers including the antimicrobial zeolites have been used to make refrigerators, dish washers, rice cookers, plastic film, vacuum bottles, plastic pails, and garbage containers. Other materials in which antimicrobial zeolites have been incorporated include flooring, wall paper, cloth, paint, napkins, plastic automobile parts, bicycles, pens, toys, sand, and concrete. Examples of such uses are described in U.S. Patents 5,714,445; 5,697,203; 5,562,872; 5,180,585; 5,714,430; and 5,102,401.

Either natural zeolites or synthetic zeolites can be used to make the antibiotic zeolites used in the present invention. "Zeolite" is an aluminosilicate having a three dimensional skeletal structure that is represented by the formula: $XM_{2/n}O \bullet Al_2O_3 \bullet YSiO_2 \bullet ZH_2O$. M represents an ion-exchangeable ion, generally a monovalent or divalent metal ion, n represents the atomic valency of the (metal) ion, X and Y represent coefficients of metal oxide and silica respectively, and Z represents the number of waters of crystallization. Examples of such zeolites include A-type zeolites, X-type zeolites, Y-type zeolites, T-type zeolites, high-silica zeolites, sodalite, mordenite, analcite,

clinoptilolite, chabazite and erionite. The present invention is not restricted to use of these specific zeolites.

The ion-exchange capacities of these zeolites are as follows: A-type zeolite = 7 meq/g; X-type zeolite = 6.4 meq/g; Y-type zeolite = 5 meq/g; T-type zeolite = 3.4 meq/g; sodalite = 11.5 meq/g; mordenite = 2.6 meq/g; analcite = 5 meq/g; clinoptilolite = 2.6 meq/g; chabazite = 5 meq/g; and erionite = 3.8 meq/g. These ion-exchange capacities are sufficient for the zeolites to undergo ion-exchange with ammonium and antimicrobial metal ions.

The specific surface area of preferred zeolite particles is preferably at least 150 m^2/g (anhydrous zeolite as standard) and the SiO_2/Al_2O_3 mol ratio in the zeolite composition is preferably less than 14, more preferably less than 11.

The antimicrobial or antibiotic metal ions (cations) used in the antibiotic zeolites should be retained on the zeolite particles through an ion-exchange reaction. Antibiotic metal ions which are adsorbed or attached without an ion-exchange reaction exhibit a decreased bactericidal effect and their antibiotic effect is not long-lasting. Nevertheless, it is advantageous for imparting quick antimicrobial action to maintain a sufficient amount of surface adsorbed metal ion.

In the ion-exchange process, the antimicrobial metal ions (cations) tend to be converted into their oxides, hydroxides, basic salts etc. either in the microforms or on the surfaces of the zeolite and also tend to deposit there, particularly when the concentration of metal ions in the vicinity of the zeolite surface is high. Such deposition tends to adversely affect the bactericidal properties of ion-exchanged zeolite.

In an embodiment of the antimicrobial zeolite, a relatively low degree of ion exchange is employed to obtain superior bactericidal properties. It is believed to be required that at least a portion of the zeolite particles retain metal ions (cations) having bactericidal properties at ion-exchangeable sites of the zeolite in an amount less than the ion-exchange saturation capacity of the zeolite. In one embodiment, the zeolite employed in the present invention retains antimicrobial metal ions in an amount up to 41% of the theoretical ion-exchange capacity of the zeolite. Such ion-exchanged zeolite with a relatively low degree of ion-exchange may be prepared by performing ion-exchange using a metal ion solution having a low concentration as compared with solutions conventionally used for ion exchange.

The zeolite preferably comprises an integral discoloration agent such as ion-exchanged ammonium. Although ammonium ions may be contained in the zeolite at a concentration as high as about 20% by weight of the zeolite, it is desirable to limit the content of ammonium ions to about 0.5 to about 2.5%, more preferably from about 0.5 to about 2.0%, and most preferably, from about 0.5 to about 1.5% by weight of the zeolite.

In the antimicrobial zeolite particles used in the present invention, ion-exchangeable ions (cations) present in zeolite, such as sodium ions, calcium ions, potassium ions and iron ions are partially replaced with antimicrobial metal ions, such as silver. The antimicrobial zeolite typically comprises from about 0.5 to about 15% and preferably from about 0.5 to about 2% by weight of ion-exchanged silver based upon 100% total weight of zeolite. Other antimicrobial metal ions may be included in the zeolite such as copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, thallium, or a combination thereof. Such ions may co-exist in the antimicrobial zeolite particles since they do not prevent the bacterial effect of the zeolite particles. These antimicrobial metal ions may be incorporated into the zeolite by themselves or in a mixture. In one embodiment, the zeolite

contains from about 0.1 to about 15% by weight of silver ions and from about 0.1 to about 8% by weight of copper or zinc ions.

The antimicrobial or antibiotic metal ion is preferably present in the range of from about 0.1 to 20wt.% of the zeolite. In one embodiment, the zeolite contain from 0.1 to 20wt.% of silver ions and from 0.1 to 20wt.% of copper or zinc ions. Although ammonium ions can be contained in the zeolite at a concentration of about 20 wt.% or less of the zeolite, it is desirable to limit the content of ammonium ions to from 0.5 to 15 wt.%, preferably 1.5 to 5 wt.%. Weight% described herein is determined for materials dried at temperatures such as 110°C, 250°C or 550°C as this is the temperature employed for the preferred post-manufacturing drying process.

A preferred antimicrobial zeolite is type A zeolite containing either a combination of ion-exchanged silver, zinc, and ammonium or silver and ammonium. One such zeolite is manufactured by Shinagawa, Inc. under the product number AW-10N and consists of 0.6% by weight of silver ion-exchanged in Type A zeolite particles having a diameter of about 2.5μ. Another formulation, AJ-10N, consists of about 2% by weight silver ion-exchanged in Type A zeolite particles having a diameter of about 2.5μ. Another formulation, AW-80, contains 0.6% by weight of silver ion-exchanged in Type A zeolite particles having a diameter of about 1.0μ. Another formulation, AJ-80N, consists of about 2% by weight silver ion-exchanged in Type A zeolite particles having a diameter of about 1.0μ. These zeolites preferably contain about between 0.5% and 2.5% by weight of ion-exchanged ammonium. A further product is AJ1OD, which consists of about 2% by weight of silver ion exchanged in Type A zeolite particles having a diameter of about 1.0μ.

The zeolite are often obtained in master batches of low density polyethylene, polypropylene, or polystyrene, containing 20 wt% of the zeolite. Thus, they can be easily mixed with the resins used as materials for forming the foam.

The antimicrobial properties of the antimicrobial zeolite particles of the invention may be assayed while in aqueous formulations using conventional assay techniques, including for example determining the minimum growth inhibitory concentration (MIC) with respect to a variety of bacteria, Eumycetes and yeast. In such a test, the bacteria listed below may be employed:

Bacillus cereus varmycoides;
Escherichia coli;
Pseudomonas aeruginosa;
Staphylococcus aureus;
Streptococcus faecalis;
Aspergillus niger;
Aureobasiduim pullulans;
Chaetomium globosum;
Gliocladium virens;
Penicillum funiculosum;
Candida albicans; and
Saccharomyces cerevisiae.

The assay for determining MIC can be carried out by smearing a solution containing bacteria for inoculation onto a plate culture medium to which a test sample of the encapsulated antibiotic zeolite particles is added in a particular concentration, followed by incubation and culturing of the plate. The MIC is defined as a minimum concentration thereof required for inhibiting the growth of each bacteria.

Safety and biocompatibility tests were conducted on the antibiotic zeolite employed in the invention. ISO 10993-1 procedures were employed. The following results were obtained:

Cytotoxicity: **Non-Toxic**
Acute Systemic Toxicity: **Non-Toxic**
Oral Toxicity: Safer than table salt
Intracutaneous Toxicity: **Passed**
Skin Irritation Test: **Non-Irritant**
Chronic Toxicity: **No Observable Effect**
In-vitro Hemolysis: **Non-Hemolytic**
30-day Muscle Implant Test: **Passed**
60-day Muscle Implant Test: **Passed**
90-day Muscle Implant Test: **Passed**
Ames Mutagenicity Test: **Passed**
Pyrogenicity: **Non-Pyrogenic**

Thus, the antibiotic zeolite are exceptionally suitable under relevant toxicity and biocompatibility standards for use in the outer screen layer, coatings and laminates.

Specific features of the invention are shown in one or more of the drawings for convenience only, as each feature may be combined with other features in accordance with the invention. Alternative embodiments will be recognized by those skilled in the art and are intended to be included within the scope of the claims. Accordingly, the above description should be construed as illustrating and not limiting the scope of the invention.

WE CLAIM:

1. A touch screen for computer input, said screen having an outer surface to be contacted by touching, said screen comprising an inorganic antimicrobial agent in sufficient amount to impart a significant antimicrobial effect to said outer surface.

2. The touch screen of claim 1, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

3. The touch screen of claim 2 wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

4. The touch screen of claim 1, wherein said touch screen is transparent.

5. A touch screen for computer input, said screen having an outer surface to be contacted by touching, wherein said screen comprises a plastic resin comprising an inorganic antimicrobial agent in sufficient amount to impart a significant antimicrobial effect to said outer surface.

6. The touch screen of claim 5, wherein said plastic resin is an elastomer.

7. The touch screen of claim 5, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

8. The touch screen of claim 7, wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

9. The touch screen of claim 8, wherein said zeolite particles are present in an amount of from 0.1 to 20.0 wt% of the total weight of said plastic resin material.

10. The touch screen of claim 9, wherein said zeolite particles are present in an amount of about 2.0 wt% and a particle size of about 1.0 micron.

11. The touch screen of claim 5, wherein said touch screen is transparent.

12. A touch screen for computer input, said screen having an outer surface to be contacted by touching, wherein said outer surface of said touch screen comprises a polymeric coating, and said inorganic antimicrobial agent is present in said polymeric coating in sufficient amount to impart a significant antimicrobial effect to said outer surface.

13. The touch screen of claim 12, wherein said polymeric coating comprises a polymer selected from the group consisting of polyurethane or an acrylic polymer.

14. The touch screen of claim 12, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

15. The touch screen of claim 14, wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

16. The touch screen of claim 15, wherein said zeolite particles are present in an amount by total weight of said polymeric coating of from about 5.0 to 45.0 wt%, and said zeolite particles have a particle size of less than 5.0 microns.

17. The touch screen of claim 12, wherein said polymeric coating is a laminate layer comprising said inorganic antimicrobial agent.

18. The touch screen of claim 17, wherein said inorganic antimicrobial agent comprises ceramic particles comprising antimicrobial metal cations.

19. The touch screen of claim 18, wherein said ceramic particles are zeolites subject to ion exchange with silver cations.

20. The touch screen of claim 12, wherein said touch screen is transparent.

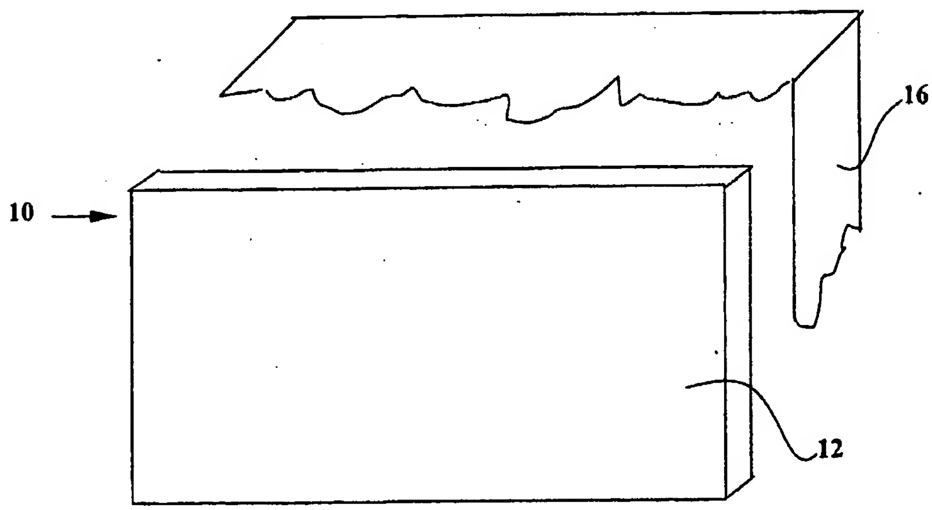


Figure 1

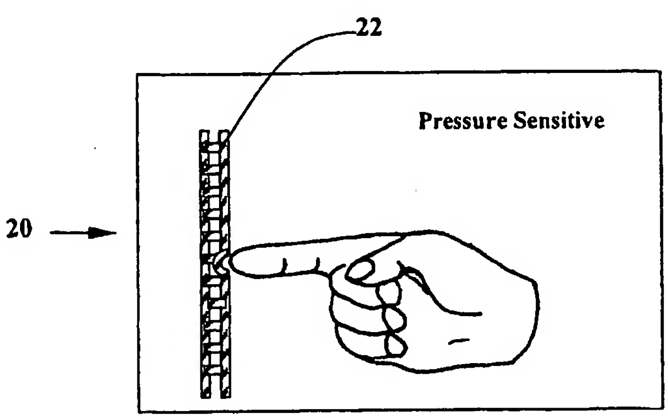


Figure 2

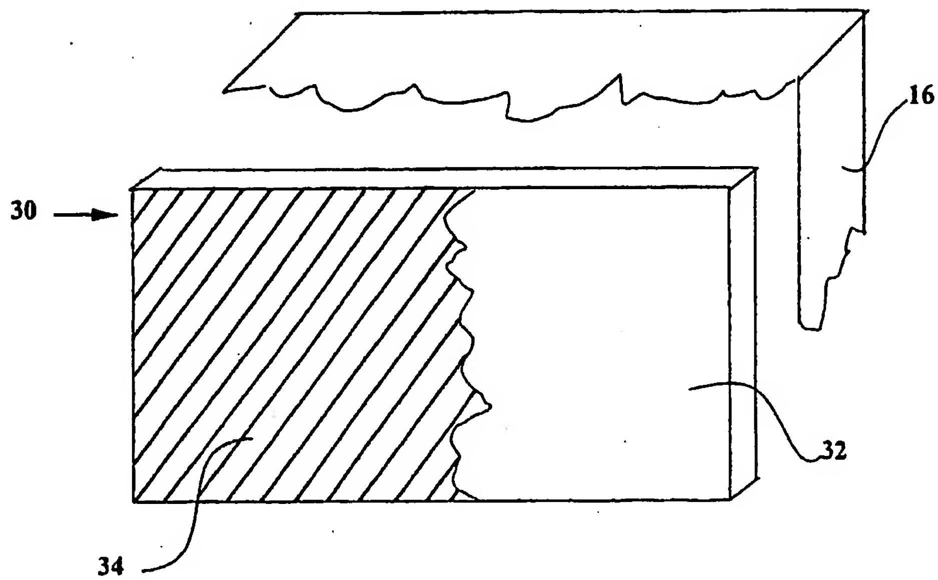


Figure 3

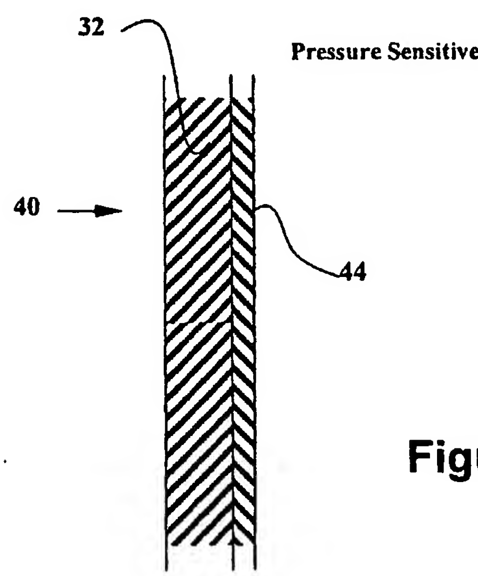


Figure 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/35018

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06K11/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06K G06F C04B C09D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 942 351 A (DAICEL CHEMICAL INDUSTRIES, LTD.) 15 September 1999 (1999-09-15) page 2, line 26 -page 3, line 58	1-4, 12-15, 17-20
A	page 6, line 4 - line 11; figure 2	5-9,11
P,A	WO 00 43831 A (MICROTOUCH SYSTEMS INC.) 27 July 2000 (2000-07-27) page 6, line 11 -page 7, line 14; claims 1-9; figures 1,2	1,4-6, 11,12, 17,20
A	DE 198 18 970 A (SAMSUNG DISPLAY DEVICES CO. LTD.) 12 November 1998 (1998-11-12) column 2, line 10 -column 3, line 23 column 3, line 67 -column 4, line 3	1,2,4, 12,17, 18,20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2001	27/04/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Taylor, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 00/35018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 942351 A	15-09-1999	JP 11110133 A	23-04-1999
		WO 9917188 A	08-04-1999
WO 0043831 A	27-07-2000	AU 2399000 A	07-08-2000
DE 19818970 A	12-11-1998	CN 1199240 A	18-11-1998
		JP 2000011921 A	14-01-2000

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☑ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: ______________________________

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.